

CLAIMS

1. Manual Control Device, which can communicate in a bidirectional way with external computers, intended for the colorimetric quality control of any type of color or monochrome document resulting from any type of production machine, by manual measurement on this document of control bars made up each one of colors patches of arbitrary specifications, and by reading on this document bar codes associated with these control bars, the Control Device deducing automatically from measurement of the control bars and from reading the bar codes a diagnosis of acceptance or rejection, by the interrogation of a specifically designed distant world data base, according to the decoded bar codes, this Control Device being characterized in that it includes:

- a light spectral analyzer (1) comprising the light entry aperture (2), a diffraction grating dispersing the light (3) and an array of photosensitive elements (4) measuring the intensity of diffracted light on each visible and close to visible wavelengths band,
- an illuminator (5) intended to illuminate the color patch to be measured on part of its area, according to the usual $45/0^\circ$ measurement geometry, the employed light source producing a visible and close to visible spectrum with sufficient intensity at each wavelength,
- a measurement aperture (6) defining the illuminated zone of the document of which reflection spectrum is to be measured,
- an optical link (7) transmitting the light reflected by the illuminated color patch to the spectral analyzer,
- a dedicated electronics or software correcting the measured gross spectrum, on each measured wavelengths

- band, by measurement in absence of light and measurement of a standard known reflection spectrum,
- a bar codes reading device according to any usual technology of the market integrated into the body of the Control Device,
 - a processing electronics allowing working and decoding the signal collected during the sweeping of a bar code,
 - a display device allowing to notify by various visual messages if requested the successful measurement of a color patch, the successful reading of a bar code, the acceptance or the rejection of the controlled document, or the ongoing interrogation of the distant data base,
 - a microprocessor provided with read-only memory, nonvolatile programmable memory and read-write memory and a program allowing to manage the control knobs of the Control Device, the extinction and lighting of the various light sources, the data-processing and bar codes decoding electronics, the realization of all desirable scientific computations from the gathered spectral data, communications with external computers, display devices, and more generally the realization of any necessary operation for the operation of the Control Device,
 - a program allowing comparing spectral measurements or their derived colorimetric or densitometric values with their respective reference values, these values being known by automatic interrogation of a universally available distant data base according to the decoded value of a bar code,
 - a battery for use without wired connection, the battery being able to be recharged by an external power pack or during a wired connection to a computer.

2. Control Device according to claim 1 characterized in that it allows manual measurement of control bars, made up each one of one or more lines of successive color patches of adapted geometry and arrangement, by means of continuous manual sweeping of each line guided if needed by a ruler, an electronics and a specialized processing software allowing this spectral acquisition by fast digitalization of the electric tensions delivered by the photosensitive elements for the acquisition of a complete gross spectrum, its memorizing, its comparison with the next acquired rough spectrum, then its replacement in memory by its iterative average with the new acquired rough spectrum, if this one is close to the average spectrum already in memory, this in order to retain as for valid final measurement of each color patch the average gross spectrum (or one of the rough average spectra previously memorized in a buffer memory envisaged for this purpose) which is held in memory at the time when a transition between two color patches appreciably modifies a new acquired spectrum compared to current average value in memory, the visual display making it then possible to notify upon request the successful acquisition of measurements of a color patches line, and two symmetrical pushbuttons working in parallel laid out on left and right of the apparatus body allowing spectral measurements by a sustained press.

3. Control Device according to claims 1 or 2 characterized in that it allows reading one-dimensional bar codes by sweeping, a laser diode (8) and its collimation optics producing a visible or infra-red or ultraviolet light spot of dimension and wavelength adapted for reading bar codes on the document (9), a

photosensitive element (10) detecting the reflected light during sweeping of a bar code.

4. Control Device according to claim 3 characterized in that several laser diodes of distinct wavelengths and associated optics (8) produce several distinct light spots, associated each one to a collimated photosensitive element (10) to detect the reflected light, thus realized configuration allowing simultaneous reading by only one sweeping of one or more independent bar codes printed in superposition, each bar code having been printed with a color complementary to one of the laser diodes, which authorizes by use of two red and blue laser diodes, superimposed impression of two bar codes of respective cyan and yellow colors, this process being able to be extended to simultaneous reading of a third Magenta color bar code printed in superposition when green laser diodes are available on the Market.

5. Control Device according to claim 4 characterized in that the laser diodes and associated optics (8) produce distinct or confused light spots (11), the reflected light resulting from each laser diode being analyzed by a photosensitive element (12) filtered at the luminous wavelength of the aforesaid laser diode.

6. Control Device according to claims 3 to 5 characterized in that the measurement aperture (6) planned for reflection spectral measurements is also used for reading bar codes by suitable integration of one or more laser diodes (8) and their respective optics.

7. Control Device according to claim 6 characterized in that the existing spectral analyzer (1) of the Control Device is used for analysis of reflected light when reading bar codes, the various employed wavelengths being separated by the diffraction grating (3) or the

photosensitive elements (4) used by wavelengths band for detection of each light signal and its conversion into electric tension for its decoding.

5 8. Control Device according to claims 6 and 7
characterized in that the very fine luminous spot(s)
provided for reading bar codes and the use of the existing
spectral analyzer are set to produce confused spots in the
document plan put at profit for realization of spectral
measurements on very small dimensions color patches after
10 calibration on the standard ceramics of the Control
Device, this one being able to aim precisely at the target
to be measured by use of a positioning reticule pierced
with a hole to be place on the measured zone and allowing
an accurate mechanical positioning of the Control Device
15 on the document or on the calibration ceramics if this one
is external to the Control Device.

9. Control Device according to any of the preceding
claims characterized in that the $45/0^\circ$ illuminator (5) is
replaced by a sphere illuminator with Diffuse/ 0° (13) or
20 0° /Diffuse (14) standardized geometry.

10. Control Device according to any of the preceding
claims characterized in that the $45/0^\circ$ illuminator (5) is
replaced by an illuminator with $0/45^\circ$ standardized
geometry (15).

25 11. Control Device according to any of the preceding
claims characterized in that the spectral analyzer with
diffraction grating (1) is replaced by a spectral filter
analyzer (16) using for luminous spectra measurement a set
of narrow band filters assembled on a rotating barrel (17)
30 in front of a photosensitive element (18) measuring each
band of the luminous spectrum through the successive
filters during the rotation of the barrel, the reading of
a monochrome bar code being then realized by using a only

one laser wavelength spot, the barrel positioning a pass band filter adapted for reading bar code by the existing photosensitive element, or reading of bar codes being made by use of photosensitive element(s) filtered at the
5 wavelengths the laser diode(s) (12).

12. Control Device according to any of the preceding claims characterized in that the light source used for reading bar codes does not consist of one or more distinct wavelengths laser diodes but of a white light source
10 focused on the document plan.

13. Control Device according to any of the preceding claims characterized in that the light source used for reading bar codes does not consist of one or more distinct wavelengths laser diodes but of one or more distinct
15 wavelengths electroluminescent diodes focused on the document plan.

14. Control Device according to any of the preceding claims other than claim 1 characterized in that, during use of manual measurement mode per continuous sweeping of
20 a line of color patches and upon user's request, the priority operating mode is spectral measurement of a line of successive color patches, then this mode commutates automatically into bar code reading mode when an arbitrary sequence of successive colors related to this bar code is
25 met (for example black - white - black - white - black), the bar code being printed after this colors arbitrary sequence and being preceded by an adapted silence zone, the Control Device being then able to consult a distant world data base according to the bar code value, if needed
30 via a connection to a local or distant computer and by using a traditional data connection of wired, wireless or infra-red type, the Control Device being able to memorize within the limit of its capacities and following User's

choice, any recording of the distant data base in order to carry out a priority research in its internal data base.

15 15. Control Device according to any of the preceding claims characterized in that a sound transducer allows
5 upon request to notify by various sound messages the successful acquisition of a measurement, or the successful reading of a bar code, or the acceptance or the rejection of the controlled document, or the ongoing interrogation of a distant data base, and the Control Device being also
10 able to read and use sets of densitometric or colorimetric reference values directly coded in the document in form of dedicated bar codes.

15 16. Control Device according to any of the preceding claims characterized in that this manual device can be used in an automated way by permanent or removable fixing
15 to a rail or a XY table moving this Control Device.

20 17. Color bar code scanner device for Users not equipped with the Control Device but wishing to read data found in a document in form of a color bar code, for the
20 use of the world data base of production configurations requiring measuring instruments such as for example transmission spectrophotometers or densitometers, for which a color bar code can be printed on a label, this device being characterized in that it includes several
25 distinct wavelengths laser diodes (8) and associated optics producing several distinct or confused light spots (11), the light resulting from each diode reflected by color bar code during its sweeping being detected by a filtered photosensitive element (12), supplemented with a
30 decoding electronics, and allowing simultaneous reading by only one sweeping of one or more independent bar codes printed in superposition.

18. Process associated with the Control Device allowing it to give a diagnosis of acceptance or rejection after having measured on any document the found control bars and read a single bar code printed at the side of the control bars, characterized in that it includes stages
5 which consist to:

- 10 a) put at the disposal of a qualified User of a machine producing color or monochrome documents on any type of media by any printing or photographic or other technology, a distant program accessible on private or public network such as Internet, allowing this User to be registered as a Person or Company and to receive an identifier and a
15 password allowing him to create his own distant data base of sets of control bars adapted to his various arbitrary production configurations, and to reach it later on, even if this User does not use the Control
20 Device yet but other measuring instrument (spectrophotometers, colorimeters or densitometers),
- b) allow the User to open a session of new recording,
- 25 c) allow the User to transmit and record the set of all parameters defining the arbitrary configuration of the production machine, this configuration determining a certain chromatic response (that can be defined by reflection
30 spectra or apparent colors under one illuminant or densities, according to a spectral response which one will obtain according to numerical values of computer

files describing the documents which will be addressed to the aforementioned machine), this arbitrary configuration being considered by the qualified User as desirable and to be retained for some productions, the using parameters affecting the chromatic response being able to include for example and in a no exhaustive way the brand, model and serial number of the production machine, types of employed inks and paper, standard densitometric calibration curves retained for the process colors when those are available in the form of a computer file, colorimetric profile of the machine (of I.C.C. type for example), various colorimetric profiles and rendering intents possibly applied to the various files composing documents (RGB, CMYK, C.I.E. XYZ, CMYKOrangeGreen etc.), possibly used simulation colorimetric profile, configuration of the machine software driver, hardware settings, version levels of hardware and software etc.

d) allow the User to transmit and record the specifications of the control bar(s) which he has designed or chosen as being essential or desirable for the quality control of the produced documents in this arbitrary production configuration, each control bar being specified by a computer file describing its geometry and its numerical values (such as RGB, CMYK, CMYKOV, C.I.E. XYZ or by any other definition or arbitrary numerical coding of the colors accepted by the printer

or its software driver in the arbitrary selected configuration), the specifications of each control bar being able to be defined by a bitmap or vector image file, or by a structured definition file of ISO type (alphanumeric), CxF (XML) or by any other forthcoming structured file format authorizing a more comprehensive definition by a same file of both the printing geometry of each control bar and the numerical values specifying the color of each color patch by any arbitrary coding,

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e) propose as an help to Users a choice of pre defined control bars designed by public or private organizations, and with printing geometries well adapted to the Control Device, or to the various manual or automatic instruments measuring spectral, colorimetric or densitometric data available on the Market,

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f) propose as an help to Users to choose among the control bars which he already specified or used for a preceding production for a new arbitrary print configuration,

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g) allow the User to download if needed the chosen control bars in form of a bitmap or vector image file, or in form of a structured definition file of ISO type, CxF or any other forthcoming structured file format authorizing a more comprehensive definition by a same file of both the printing geometry of each control bar and numerical values

specifying the color of each color patch by any arbitrary coding,

- 5 h)allow the User for each specified or chosen control bar, to upload and record each set of spectral, colorimetric or densitometric associated reference values, for example in the form of an alphanumeric ISO measurements file,
- 10 i)allow the User to choose or specify several times the same control bar, if several distinct sets of reference values must be associated to this same control bar, as for example a set of densitometric values and a set of colorimetric value, or two distinct
- 15 sets of densitometric values according to two different measurement spectral responses,
- 20 j)allow the User to declare or transmit and to record, for each control bar, the selected type of control (spectral or colorimetric or densitometric), and according to this selected type of control, allowed tolerances, standard or measured illuminant, mode of calculation of the colorimetric values, type of visual distance formula specifying the
- 25 tolerances, densitometric spectral response to be used, and more generally all measurement conditions to apply when reading each control bar for the acquisition of spectral measurements and derived
- 30 colorimetric and densitometric measurements calculations, such as the choice of a black or white background under the document, the type, brand, model, measurement geometry and

instrument optical filtering used for the establishment of the reference values, each set of reference values transmitted and recorded by the User having been, at user's convenience, obtained by measurement of the control bar during a production test, and/or having been foreseen by calculation by using colorimetric profile(s) associated to this arbitrary production configuration, or by using spectral or colorimetric measurements file(s) of printed test charts having allowed computing this (these) colorimetric profile(s),

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k) provide help if needed to the User for the determination of reference values which are foreseeable by remote automatic calculation by using the various colorimetric profiles or spectral or colorimetric measurements files having allowed computing this (these) colorimetric profile(s), that can be uploaded using, for example, the standardized ISO alphanumeric format,

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l) allow the User, after a test print run of the set of chosen control bars, to measure these control bars, check the differences between the foreseeable reference values computed from colorimetric profiles or according measurements files, and the actual measured values,

m) provide if needed help to the User, if the preceding test shows, for one or more control bars, out of tolerances differences between the measured values and the foreseen values

computed from the colorimetric profile(s) or
from the measurements file(s) having allowed
to establish this (these) profile(s), this
help being able to point out a densitometric
5 calibration drift of the production machine
affecting all or part of its process colors,
this allowing then a densitometric
recalibration if the machine technical
specifications allow this calibration, or in
10 the contrary case an actualization of the
colorimetric profile of machine allowing the
establishment of corrected reference values,
the on-line help being also able to point out
a drift of characteristics of a process color
15 or of the document media requiring also an
actualization of the colorimetric profile of
the machine and the establishment of
corrected reference values or an action
towards the suppliers of these consumable,
20 n) provide if needed and asked by the User in
the preceding case, an improved colorimetric
profile by distant calculation by using the
initial uploaded colorimetric profile, the
values actually measured on the control bars
25 during the production test and the different
reference values initially foreseen by
calculation,
o) allow the User, after a test production of
the set of control bars and measurement of
30 these control bars, to validate all of the
preceding choices for his arbitrary
production configuration allowing later
control of thus defined production,

p)allow the User after this validation to definitively lock the recording describing completely all parameters of this arbitrary production configuration and production quality control, any modification of one of the control bars related to the printing configuration, or addition of an additional control bar, or any modification of the measurement conditions of one of the control bars implying the necessity of redefining a complete new set of control bars which will imply the generation of a new alphanumeric identifier,

q)generate and transmit to the User the single alphanumeric identifier of the recording characterizing this arbitrary production configuration and production quality control, in any practical form: bitmap or vector image of a bar code according to any arbitrary coding and in any form of usual or forthcoming computer file, or the identifier itself in any form of coding or arbitrary representation, the bar code or any form of representation of the single identifier being incorporated into the documents to be produced in this production configuration by the data-processing programs participating to the realization of the document object of this production, or by the printer or by its software driver, in the purpose of its reproduction with the control bars related to thus defined production and production quality control configuration,

- 5 r)put at the disposal of everybody on a distant
server accessible by private or public
network such as Internet all data of the
recording which are necessary for the
acceptance or the rejection of the document
by the Control Device, and, at User's choice,
any other information nonessential for the
colorimetric quality control of the document,
the value of the decoded bar code by the
10 Control Device being one index of the
recording,
- 15 s)allow the User to download a program allowing
him to locally transform any single
alphanumeric identifier into a computer file
representing the identifier in the form of a
bar code according to an arbitrary coding,
- 20 t)allow the User to download a bitmap or vector
image file in any usual form, representing
each of the chosen control bars and the
associated bar code representing the single
identifier, this image having a geometry
adapted to the physical format of his
production machine and to the Control Device
or to the various manual or automatic
25 instruments available on the Market measuring
spectral, colorimetric or densitometric
values,
- 30 u)provide if needed help to the User, if during
a production run out of tolerance drifts
between the measured values and the recorded
reference values are measured, this help
being able to point out a densitometric
calibration drift of the production machine

on all or part of its process colors requiring if the machine technical specifications allow it, a densitometric recalibration, or in the contrary case an
5 actualization of the colorimetric profile of the machine allowing the establishment of corrected reference values, the on-line help being also able to point out a drift of characteristics of a process color or of the
10 document media requiring also an actualization of the machine colorimetric profile and the establishment of corrected reference values, or an action towards the suppliers of these consumable,

15 v)allow if the preceding case shows a need for establishing new reference values following the impossibility of restoring the original chromatic response of the production machine by action on its calibration or by corrective
20 action on the employed consumable, a fast redefinition of the new reference values attached to the control bars, their validation, and the attribution of a new identifier suitable for the new production
25 configuration thus carried out.

w)allow the User to download a program allowing him to realize all preceding operations by using a local Intranet server synchronized with the distant server in the event of
30 failure of the distant connection or for simple purpose of convenience,

x)allow the User to acquire in advance single identifiers for his Intranet server.

19. Process according to claim 18 characterized in that it makes it possible to transmit to the User, in addition to the single identifier characterizing the production configuration and production quality control, a
5 bar code representing this identifier, and one or more complementary bar codes coding directly the numerical reference values attached to the main control bar of this production configuration, this main control bar being intended to check the chromatic response stability of the
10 production machine, this main control bar being constituted, for example on professional photographic machines, of several measurable gray patches of various densities according to a standardized type A spectral response, and constituted for CMYK printing presses of
15 several color patches specified at various arbitrary densities for each process color, these densities being measurable according to a limited number of standardized spectral responses, the spectral response and possible source filtering used by the measurement instrument being
20 then indicated by the complementary bar codes.

20. Process according to claim 19 characterized in that it allows to extend direct coding of reference densities in the form of complementary bar codes to an unspecified number of process colors, of which each one is
25 measured according to a non standardized spectral response specifically adapted to this measured process color, as well as directly coding by the bar codes the color measurements of the media and of each process color.